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Shinagawa

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(54) **IMAGE FORMING APPARATUS CONFIGURED TO SET AN INITIAL VALUE OF AN AMOUNT OF RECORDING MATERIAL REMAINING IN A CONTAINING UNIT, ASSOCIATED CONTROL METHOD, AND STORAGE MEDIUM**

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G03G 15/08 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/556*** (2013.01); *G03G 15/0863* (2013.01)

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CPC ... G03G 15/55; G03G 15/553; G03G 15/556; G03G 15/0863; G03G 2215/0695; G03G 2215/0697; G03G 21/1878; G03G 21/1882; G03G 21/1885; G03G 21/1889; G03G 21/1892; G03G 21/1896
See application file for complete search history.

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2005/0163514	A1 *	7/2005	Hwang	399/8
2010/0172659	A1 *	7/2010	Jeon	G03G 15/553 399/12
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(57) **ABSTRACT**

When a toner cartridge is mounted to an image forming apparatus, if the toner cartridge is new, the image forming apparatus sets a value calculated from cartridge capacity as an initial value of a toner remaining amount. If, when the toner cartridge is mounted to the image forming apparatus, the toner cartridge is not new, the image forming apparatus sets a value calculated from a page count number as the initial value of the toner remaining amount. Furthermore, when the toner cartridge is mounted to the image forming apparatus, the image forming apparatus acquires a sensor value, and if the acquired sensor value is an indefinite value, the image forming apparatus determines an alternative value according to sensor ability as the initial value of the toner remaining amount.

18 Claims, 8 Drawing Sheets

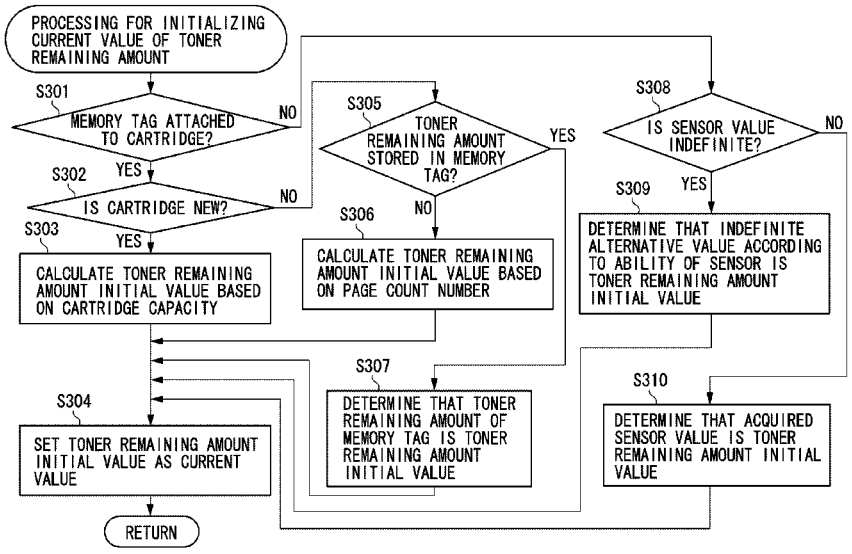
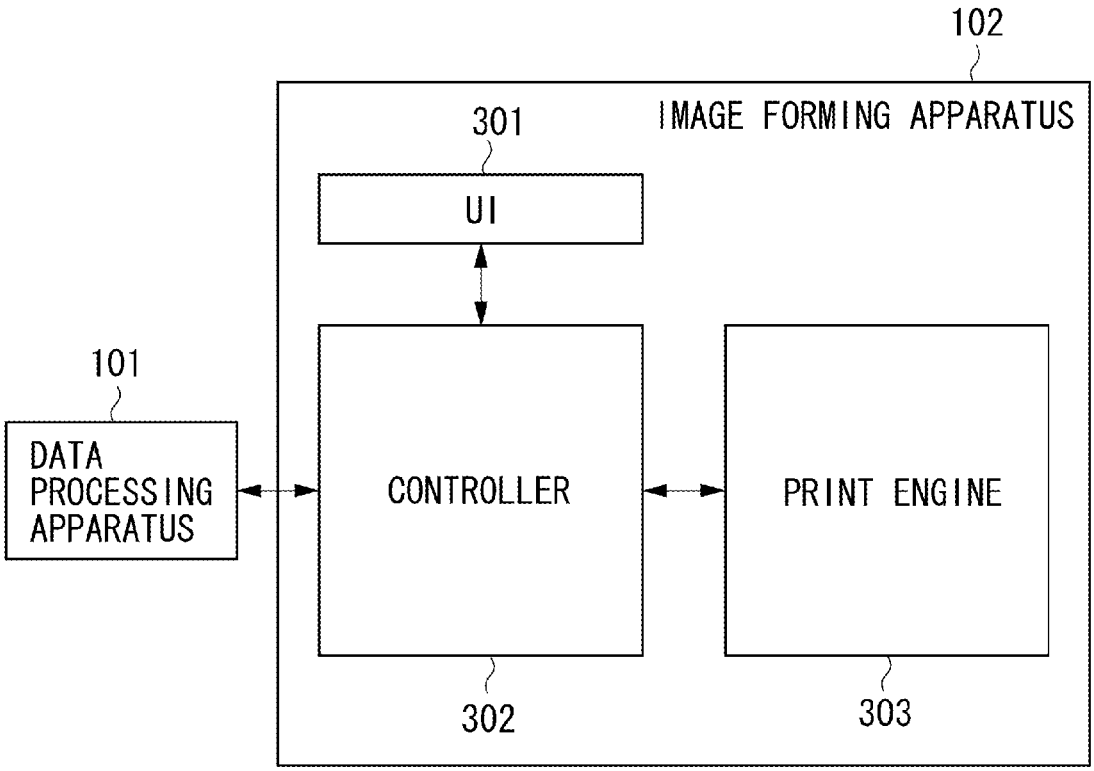


FIG. 1


102
IMAGE FORMING APPARATUS
301
UI
101
DATA PROCESSING APPARATUS
CONTROLLER
PRINT ENGINE
302
303

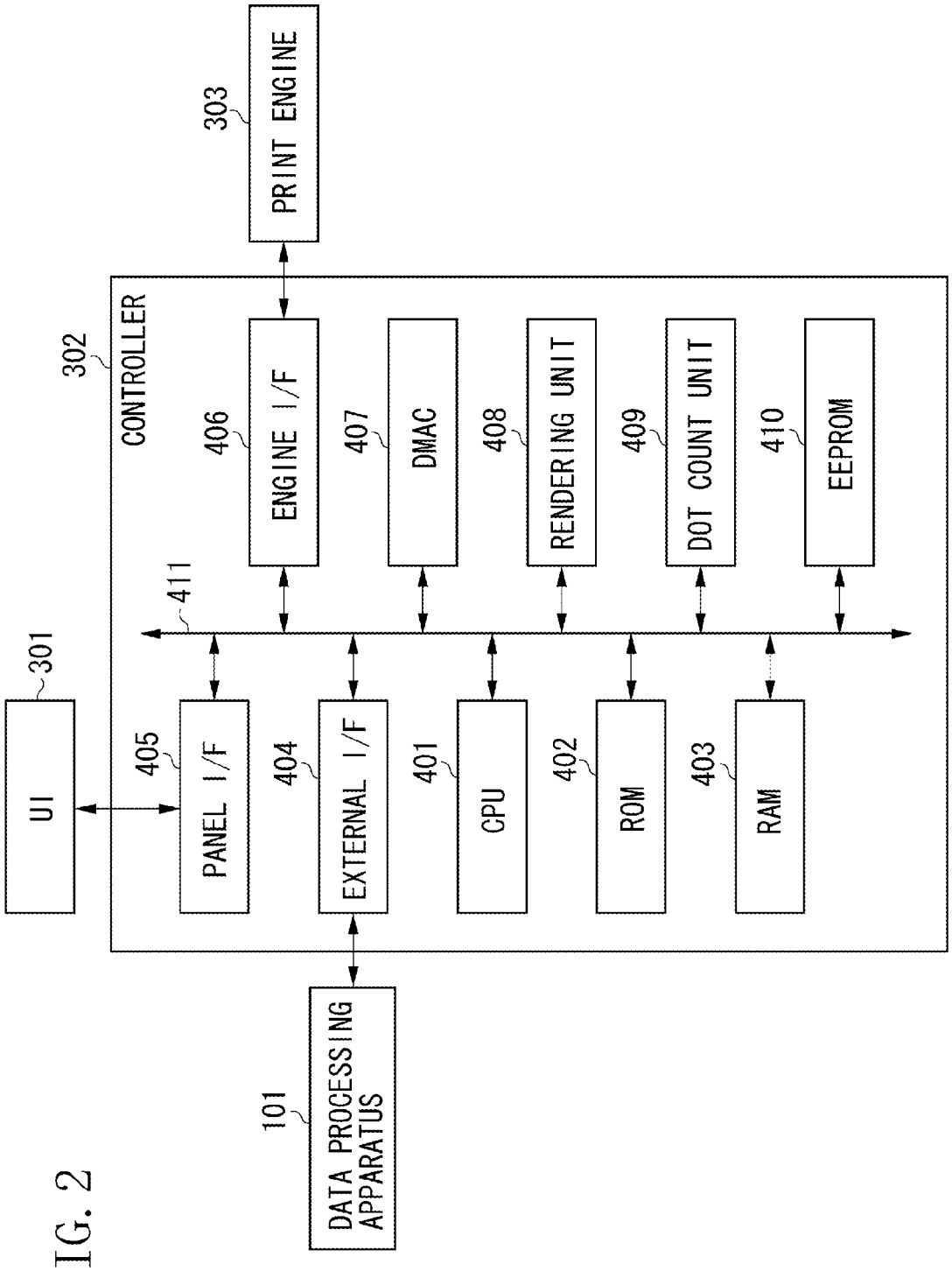

303
PRINT ENGINE
302
CONTROLLER
406
ENGINE I/F
407
DMAC
408
RENDERING UNIT
409
DOT COUNT UNIT
410
EEPROM
411
301
UI
405
PANEL I/F
404
EXTERNAL I/F
401
CPU
402
ROM
403
RAM
101
DATA PROCESSING APPARATUS

FIG. 2

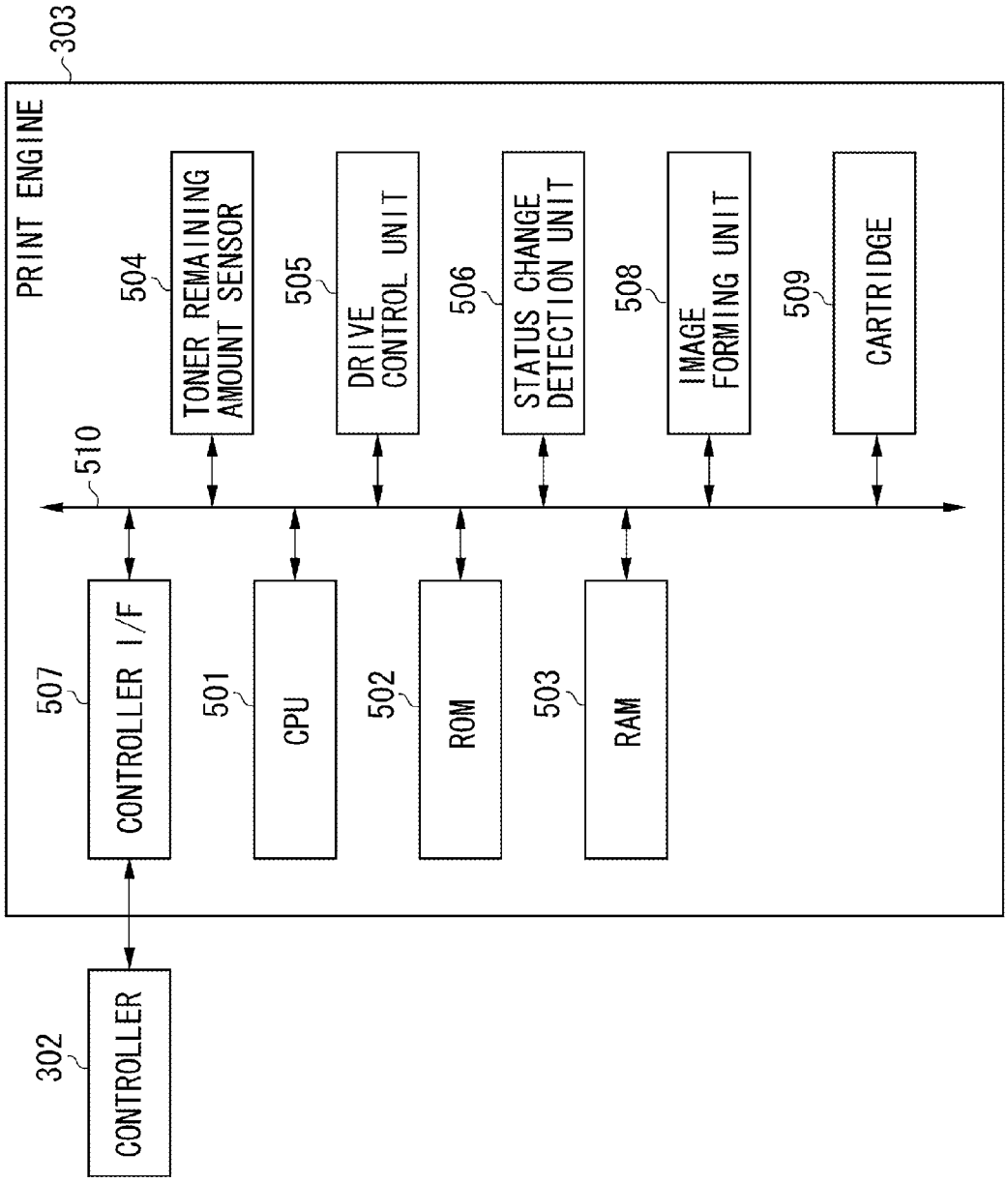

303
PRINT ENGINE
504
TONER REMAINING AMOUNT SENSOR
505
DRIVE CONTROL UNIT
506
STATUS CHANGE DETECTION UNIT
508
IMAGE FORMING UNIT
509
CARTRIDGE
510
507
CONTROLLER I/F
501
CPU
502
ROM
503
RAM
302
CONTROLLER

FIG. 3

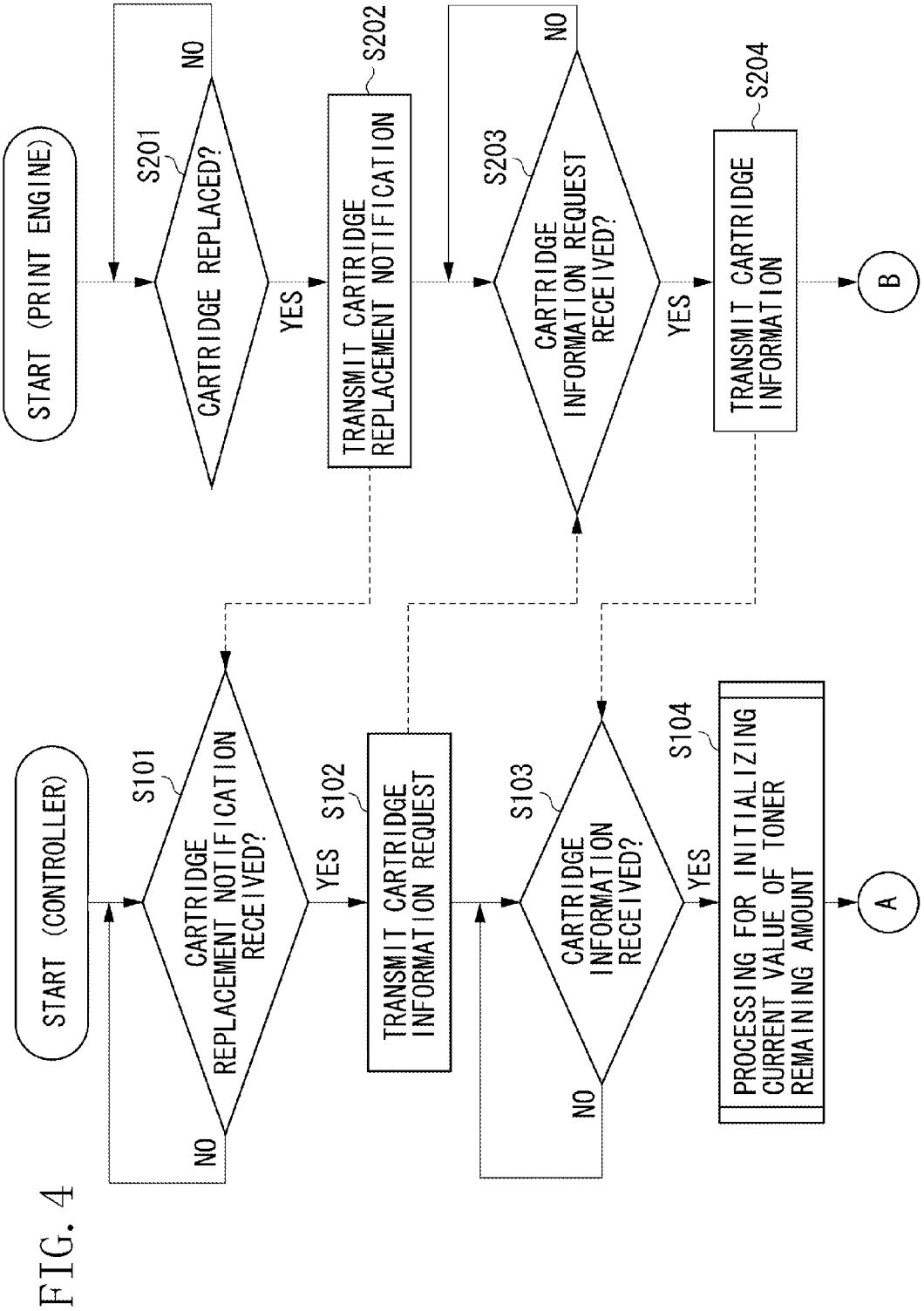

START (CONTROLLER)
S101
CARTRIDGE REPLACEMENT NOTIFICATION RECEIVED?
NO
YES
S102
TRANSMIT CARTRIDGE INFORMATION REQUEST
S103
CARTRIDGE INFORMATION RECEIVED?
NO
YES
S104
PROCESSING FOR INITIALIZING CURRENT VALUE OF TONER REMAINING AMOUNT
A
START (PRINT ENGINE)
S201
CARTRIDGE REPLACED?
NO
YES
S202
TRANSMIT CARTRIDGE REPLACEMENT NOTIFICATION
S203
CARTRIDGE INFORMATION REQUEST RECEIVED?
NO
YES
S204
TRANSMIT CARTRIDGE INFORMATION
B

FIG. 4

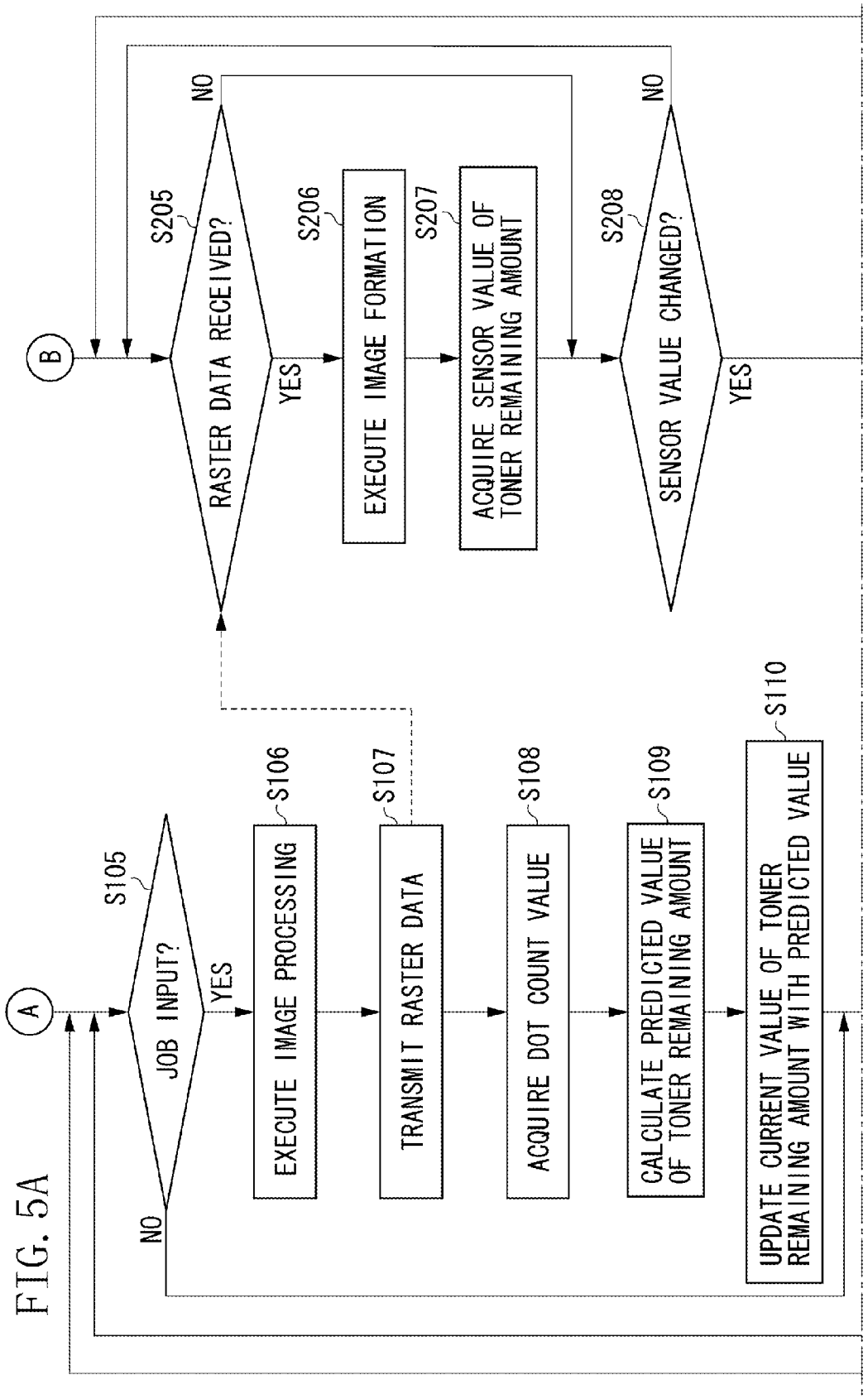

A
JOB INPUT?
S105
YES
NO
EXECUTE IMAGE PROCESSING
S106
TRANSMIT RASTER DATA
S107
ACQUIRE DOT COUNT VALUE
S108
CALCULATE PREDICTED VALUE OF TONER REMAINING AMOUNT
S109
UPDATE CURRENT VALUE OF TONER REMAINING AMOUNT WITH PREDICTED VALUE
S110
B
RASTER DATA RECEIVED?
S205
YES
NO
EXECUTE IMAGE FORMATION
S206
ACQUIRE SENSOR VALUE OF TONER REMAINING AMOUNT
S207
SENSOR VALUE CHANGED?
S208
YES
NO

FIG. 5A

FIG. 5B

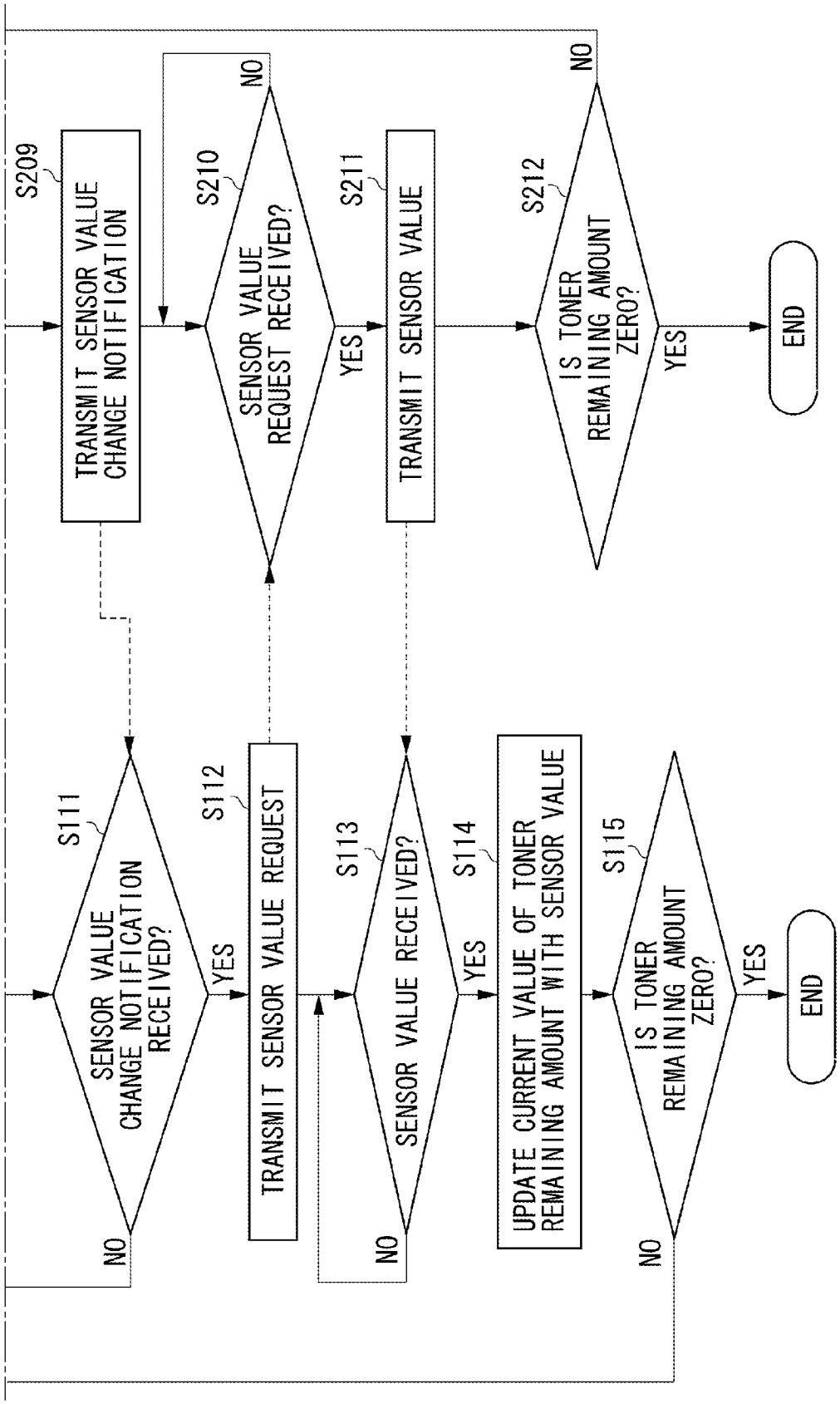

S111
SENSOR VALUE CHANGE NOTIFICATION RECEIVED?
NO
YES
S112
TRANSMIT SENSOR VALUE REQUEST
S113
SENSOR VALUE RECEIVED?
NO
YES
S114
UPDATE CURRENT VALUE OF TONER REMAINING AMOUNT WITH SENSOR VALUE
S115
IS TONER REMAINING AMOUNT ZERO?
NO
YES
END
S209
TRANSMIT SENSOR VALUE CHANGE NOTIFICATION
S210
SENSOR VALUE REQUEST RECEIVED?
NO
YES
S211
TRANSMIT SENSOR VALUE
S212
IS TONER REMAINING AMOUNT ZERO?
NO
YES
END

FIG. 6

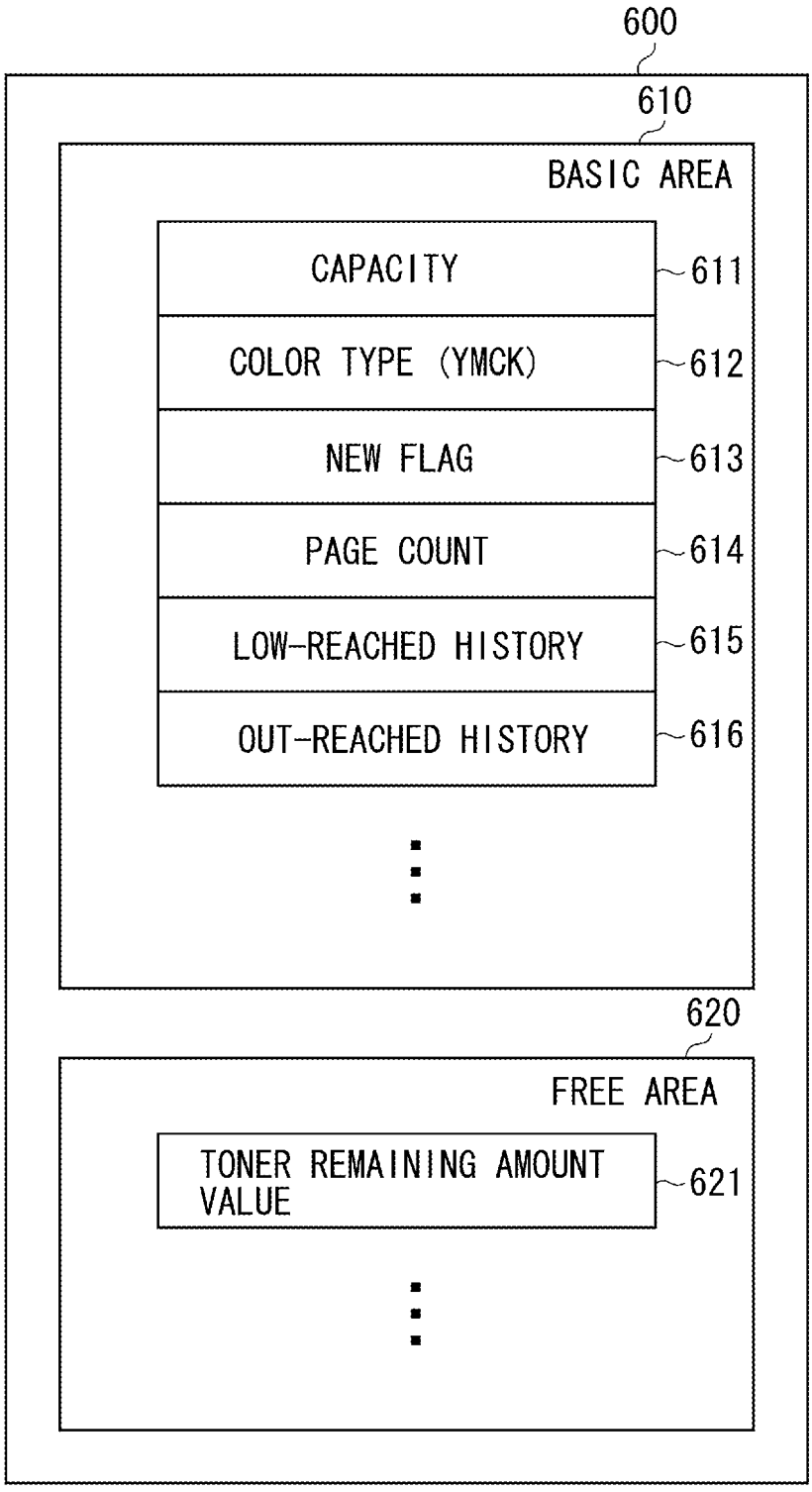

600
610
BASIC AREA
CAPACITY
611
COLOR TYPE (YMCK)
612
NEW FLAG
613
PAGE COUNT
614
LOW-REACHED HISTORY
615
OUT-REACHED HISTORY
616
620
FREE AREA
TONER REMAINING AMOUNT VALUE
621

FIG. 7

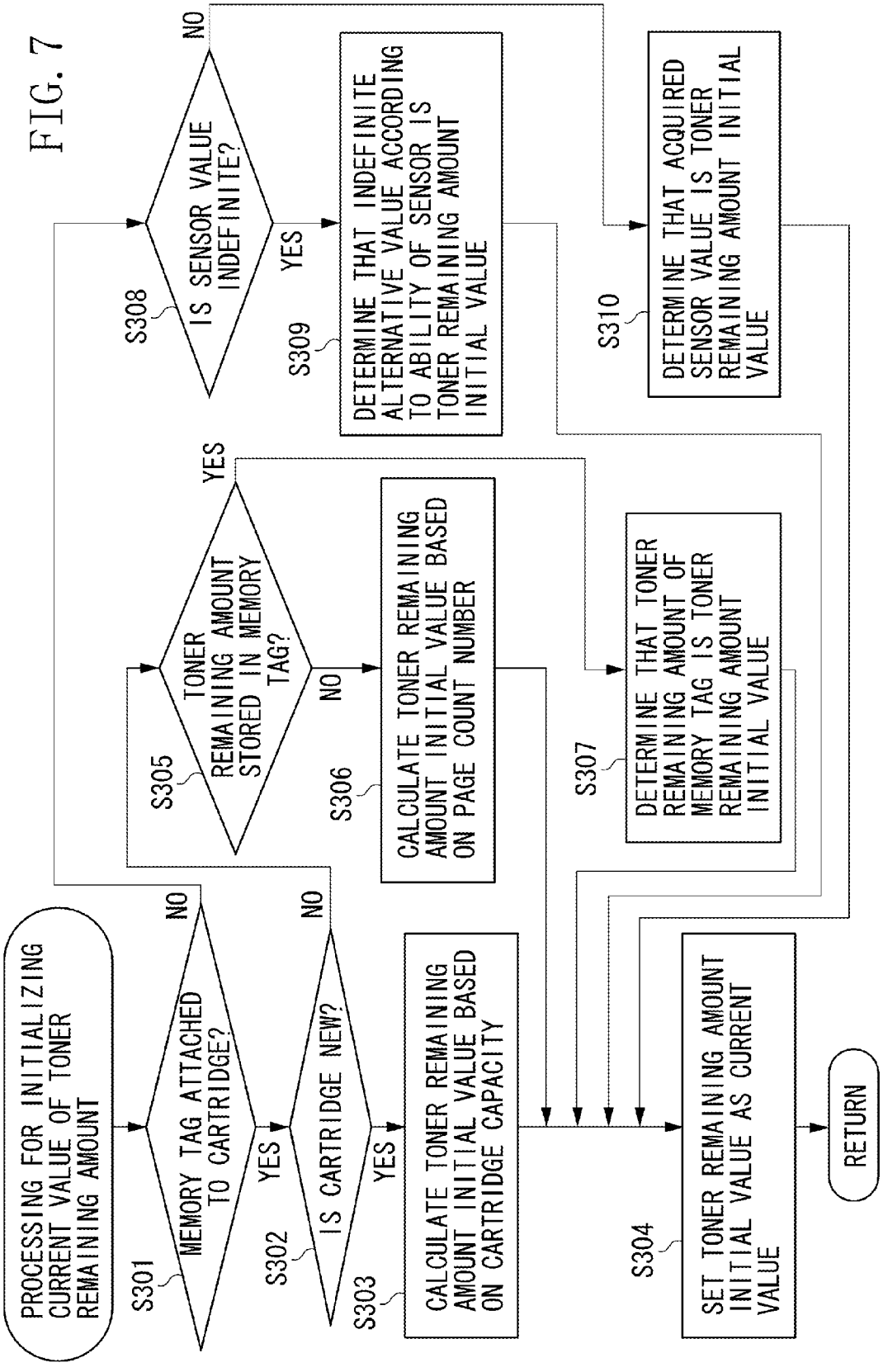

PROCESSING FOR INITIALIZING CURRENT VALUE OF TONER REMAINING AMOUNT
S301
MEMORY TAG ATTACHED TO CARTRIDGE?
NO
YES
S302
IS CARTRIDGE NEW?
NO
YES
S303
CALCULATE TONER REMAINING AMOUNT INITIAL VALUE BASED ON CARTRIDGE CAPACITY
S304
SET TONER REMAINING AMOUNT INITIAL VALUE AS CURRENT VALUE
RETURN
S305
TONER REMAINING AMOUNT STORED IN MEMORY TAG?
YES
NO
S306
CALCULATE TONER REMAINING AMOUNT INITIAL VALUE BASED ON PAGE COUNT NUMBER
S307
DETERMINE THAT TONER REMAINING AMOUNT OF MEMORY TAG IS TONER REMAINING AMOUNT INITIAL VALUE
S308
IS SENSOR VALUE INDEFINITE?
NO
YES
S309
DETERMINE THAT INDEFINITE ALTERNATIVE VALUE ACCORDING TO ABILITY OF SENSOR IS TONER REMAINING AMOUNT INITIAL VALUE
S310
DETERMINE THAT ACQUIRED SENSOR VALUE IS TONER REMAINING AMOUNT INITIAL VALUE

IMAGE FORMING APPARATUS CONFIGURED TO SET AN INITIAL VALUE OF AN AMOUNT OF RECORDING MATERIAL REMAINING IN A CONTAINING UNIT, ASSOCIATED CONTROL METHOD, AND STORAGE MEDIUM

BACKGROUND

1. Field

Aspects of the present invention generally relate to an image forming apparatus, a control method, and a storage medium.

2. Description of the Related Art

Image forming apparatuses form an image on a sheet using a recording material such as toner. In general, the recording material is contained in a containing unit such as a cartridge. Some image forming apparatuses detect the amount of recording material remaining in the containing unit, and display a value acquired by the detection on a display unit such as a user interface (UI).

Conventionally, a sensor has been provided, and a value detected by the sensor has been directly displayed as the amount of remaining recording material. In many cases, there has been adopted a sensor capable of demonstrating high detection accuracy only when the remaining amount is smaller than a certain level, in view of factors such as cost. In such cases, the sensor discretely detects, for example, 100%, 20%, and 0% as the amount of remaining recording material. Accordingly, the display unit also discretely displays, for example, 100%, 20%, and 0% as the amount of remaining recording material.

In contrast, Japanese Patent Application Laid-Open No. 2006-343621 discusses a technique for displaying on a display unit the amount of remaining recording material in continuous percentages while adopting a sensor that discretely detects a remaining amount. For example, when image formation is performed, a predicted value of a toner remaining amount is calculated based on a dot count value of raster data. The calculated predicted value is then displayed as a current value of the toner remaining amount. When a sensor value of the toner remaining amount is acquired from the sensor, the current value is updated with the acquired sensor value.

When a toner cartridge is replaced, it is necessary to initialize the current value of the toner remaining amount. Therefore, a toner remaining amount value stored in a memory tag of the toner cartridge is adopted as an initial value of the toner remaining amount.

However, when the toner remaining amount value is not stored in the memory tag of the toner cartridge, the current value of the toner remaining amount cannot be appropriately initialized. Therefore, the toner remaining amount cannot be appropriately displayed at least until the sensor detects the toner remaining amount.

SUMMARY

Aspects of the present invention are generally directed to an image forming apparatus capable of appropriately initializing a current value of a toner remaining amount even if a toner remaining amount value is not stored in a memory tag of a toner cartridge when the toner cartridge is mounted.

According to an aspect of the present invention, an image forming apparatus performing image formation using a recording material stored in a containing unit includes an acquisition unit configured to acquire information from the containing unit when the containing unit is mounted to the image forming apparatus, the information indicating a number of pages for which image formation is executable using the recording material stored in the containing unit from a state in which the containing unit is new, a calculation unit configured to calculate, based on the information, an amount of the recording material remaining in the containing unit if a new containing unit is mounted to the image forming apparatus, and a setting unit configured to set a value representing the amount calculated by the calculation unit as an initial value of an amount of the recording material remaining in the containing unit.

Further features of the present disclosure will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating a configuration of an image forming apparatus.

FIG. **2** is a block diagram illustrating a configuration of a controller.

FIG. **3** is a block diagram illustrating a configuration of a print engine.

FIG. **4** is a flowchart (a first half) illustrating control for detecting a toner remaining amount.

FIGS. **5**A and **5**B are flowcharts (a second half) illustrating the control for detecting the toner remaining amount.

FIG. **6** is a diagram illustrating a data configuration of a memory tag.

FIG. **7** is a flowchart illustrating details of processing for initializing a current value of the toner remaining amount.

DESCRIPTION OF THE EMBODIMENTS

FIG. **1** is a block diagram illustrating a configuration of an image forming apparatus according to a first exemplary embodiment.

A data processing apparatus **101** (e.g., a personal computer (PC)) generates image data, and transmits the generated image data to an image forming apparatus **102**.

The image forming apparatus **102** (e.g., a laser beam printer) receives the image data from the data processing apparatus **101**, and forms an image on a sheet based on the received image data. The image forming apparatus **102** may be a multi-function peripheral having functions such as a scanner function and a fax function.

A UI **301** has a display unit displaying various types of information to a user, and an operation unit accepting various operations from the user. On the display unit, a current value of a toner remaining amount, which will be described below, is displayed. The current value of the toner remaining amount may be transmitted to an external apparatus such as the data processing apparatus **101** via an external interface (I/F), and displayed on a display unit of the external apparatus.

A controller **302** generates bitmap data based on page-description language (PDL) data, and transmits the generated bitmap data to a print engine **303**. The controller **302** will be described in detail below with reference to FIG. **2**.

Based on the bitmap data received from the controller **302**, the print engine **303** performs image formation on a sheet by using toner in an electrophotographic method. The method of the image formation may be methods other than the electrophotographic method, for example, an inkjet method. In such a case, a recording material in the inkjet method is ink whereas a recording material in the electrophotographic method is toner.

The controller **302** and the print engine **303** are provided as separate components, but may be combined into one unit.

FIG. **2** is a block diagram illustrating a configuration of the controller **302**.

A central processing unit (CPU) **401** controls the image forming apparatus **102** by loading, into a random-access memory (RAM) **403**, a program stored in a read-only memory (ROM) **402**, and executing the program. Further, as described below, the CPU **401** calculates a toner remaining amount, based on a predicted value of a toner consumption amount and a sensor value of a toner remaining amount. The predicted value of the toner consumption amount is converted from a dot count value acquired by a dot count unit **409**. The CPU **401** is notified by the print engine **303** of the sensor value of the toner remaining amount. The CPU **401** then causes the UI **301** to display the calculated toner remaining amount via a panel I/F **405**, or notifies the data processing apparatus **101** of the calculated toner remaining amount via an external I/F **404**.

The ROM **402** stores information such as the program to be executed by the CPU **401**.

The RAM **403** stores information such as the program loaded from the ROM **402**. The RAM **403** also stores PDL data, intermediate data generated by interpreting the PDL data, bitmap data generated by rendering the intermediate data, and temporary statuses of various types of processing and log information that are necessary for other processing.

The external I/F **404** interconnects the data processing apparatus **101** and the controller **302**, and relays data communication, i.e., transmission and reception of data, performed therebetween.

The panel I/F **405** interconnects the UI **301** and the controller **302**, and relays data communication, i.e., transmission and reception of data, performed therebetween.

An engine I/F **406** interconnects the print engine **303** and the controller **302**, and relays data communication, i.e., transmission and reception of data, performed therebetween.

A direct memory access controller (DMAC) **407** performs data access to the RAM **403**, i.e., writing and reading of data into and from the RAM **403**, upon receipt of a command from the CPU **401**.

A rendering unit **408** rasterizes the intermediate data into the bitmap data.

The dot count unit **409** counts the number of dots consuming the toner in image formation, among dots included in the rasterized bitmap data. Specifically, the dot count unit **409** counts the number of dots corresponding to colors other than white. For example, in a case of monochrome printing, the dot count unit **409** counts the number of dots corresponding to K (black). In a case of color printing, the dot count unit **409** counts the number of dots corresponding to any ofY (yellow), M (magenta), C (cyan), and K (black). The CPU **401** or the rendering unit **408** may count the number of dots.

An electrically erasable programmable ROM (EEPROM) **410** stores information such as setting information of the image forming apparatus **102**.

A bus **411** interconnects components in the controller **302**.

FIG. **3** is a block diagram illustrating a configuration of the print engine **303**.

A CPU **501** controls the print engine **303** by loading into a RAM **503** a program stored in a ROM **502**, and executing the program.

The ROM **502** stores information such as the program to be executed by the CPU **501**.

The RAM **503** stores information such as the program loaded from the ROM **502**.

A toner remaining amount sensor **504** measures the amount of toner remaining in a cartridge **509**. Examples of a method for detecting the toner remaining amount employed in the toner remaining amount sensor **504** include a permeability detecting method, a magnetic method, a piezoelectric vibration method, and a transmitted light method. When the toner remaining amount reaches a predetermined value such as 20% and 0%, the toner remaining amount sensor **504** detects the value as the sensor value. More specifically, as the sensor value, the toner remaining amount sensor **504** detects "100%" when the toner remaining amount is in a range of 100% to 21%, "20%" when the toner remaining amount is in a range of 20% to 1%, and "0%" when the toner remaining amount is 0%. The toner remaining amount sensor **504** may be provided inside the cartridge **509**.

A drive control unit **505** drives various motors that are necessary for an image forming unit **508** to perform image formation.

A status change detection unit **506** detects a status change such as a jam and cover opening in the image forming apparatus **102**. The status change detection unit **506** further detects replacement of the cartridge **509**. The status change may be detected by the CPU **501**.

A controller I/F **507** interconnects the controller **302** and the print engine **303**, and relays data communication, i.e., transmission and reception of data, performed therebetween.

The image forming unit **508** performs image formation on a sheet by using the toner in the electrophotographic method, based on the bitmap data received from the controller **302**.

The cartridge **509** is a process cartridge mountable to the image forming apparatus **102**, as a containing unit containing the toner. The cartridge **509** stores the toner to be used when the image forming unit **508** performs image formation. Further, the cartridge **509** includes a nonvolatile storage medium that stores cartridge information therein. Examples of the cartridge information include information indicating whether the cartridge **509** is new, color information indicating the color of the cartridge **509**, and toner remaining amount information indicating the amount of the toner currently remaining in the cartridge **509**. Although the cartridge **509** is connected to a bus **510**, the cartridge **509** may be connected to the CPU **501** via a dedicated line.

The bus **510** interconnects components in the print engine **303**.

FIGS. **4**, **5**A, and **5**B illustrate flowcharts indicating control for detecting the toner remaining amount.

In each of FIGS. **4**, **5**A, and **5**B, the flowchart on the left indicates the control performed by the CPU **401** in the controller **302**. This control is implemented when the CPU **401** loads a control program stored in the ROM **402** into the RAM **403** to execute the control program. On the other hand, the flowchart on the right indicates the control performed by the CPU **501** in the print engine **303**. This control is implemented when the CPU **501** loads a control program stored in the ROM **502** into the RAM **503** to execute the control program.

First, in step S**201**, the CPU **501** determines whether the cartridge **509** has been replaced. This determination is made by detecting that the cartridge **509** has been newly mounted to the image forming apparatus **102**. The mounted cartridge **509** is recognized when the status change detection unit **506** detects that the cartridge **509** has been mounted and notifies the CPU **501** of the detection. The mounted cartridge **509** may be detected by detecting opening/closing of a cover provided for replacing the cartridge **509**. Alternatively, the mounted cartridge **509** may be detected via a button or a switch whose ON/OFF state changes in hardware in response to a component being mounted or removed. When the CPU **501** deter-

mines that the cartridge **509** has been replaced (YES in step S**201**), the CPU **501** proceeds to step S**202**. When the CPU **501** determines that the cartridge **509** has not been replaced (NO in step S**201**), the CPU **501** stays on standby.

Then, in step S**202**, the CPU **501** transmits a cartridge replacement notification indicating that the cartridge **509** has been replaced to the controller **302** via the controller I/F **507**.

Next, in step S**101**, the CPU **401** determines whether the cartridge replacement notification has been received from the print engine **303** via the engine I/F **406**. When the CPU **401** determines that the cartridge replacement notification has been received (YES in step S**101**), the CPU **401** proceeds to step S**102**. When the CPU **401** determines that the cartridge replacement notification has not been received (NO in step S**101**), the CPU **401** stays on standby.

Then, in step S**102**, the CPU **401** transmits a cartridge information request for requesting cartridge information of the cartridge **509** to the print engine **303** via the engine I/F **406**.

Next, in step S**203**, the CPU **501** determines whether the cartridge information request has been received from the controller **302** via the controller I/F **507**. When the CPU **501** determines that the cartridge information request has been received (YES in step S**203**), the CPU **501** proceeds to step S**204**. When the CPU **501** determines that the cartridge information request has not been received (NO in step S**203**), the CPU **501** stays on standby.

Then, in step S**204**, the CPU **501** transmits the cartridge information of the cartridge **509**, to the controller **302** via the controller I/F **507**.

Next, in step S**103**, the CPU **401** determines whether the cartridge information has been received from the print engine **303** via the engine I/F **406**. When the CPU **401** determines that the cartridge information has been received (YES in step S**103**), the CPU **401** proceeds to step S**104**. When the CPU **401** determines that the cartridge information has not been received (NO in step S**103**), the CPU **401** stays on standby.

Then, in step S**104**, the CPU **401** initializes the current value of the toner remaining amount based on the cartridge information. Here, the current value of the toner remaining amount is a value recognized by the controller **302** as the toner remaining amount of the cartridge **509**, and displayed to a user via the UI **301**. The current value of the toner remaining amount is held in a memory such as the RAM **403**. This step S**104** will be described in detail below with reference to FIG. **7**.

Then, in step S**105**, the CPU **401** determines whether a job demanding execution of image formation has been input from the data processing apparatus **101** via the external I/F **404**. Here, examples of the job include a PDL print job, a copy job, and a FAX reception print job. When the CPU **401** determines that the job has been input (YES in step S**105**), the CPU **401** proceeds to step S**106**. When the CPU **401** determines that the job has not been input (NO in step S**105**), the CPU **401** proceeds to step S**111**.

Next, in step S**106**, the CPU **401** executes image processing necessary for the image formation based on the job. Here, the image processing includes processing for generating raster data by controlling the rendering unit **408** to rasterize print data.

Then, in step S**107**, the CPU **401** transmits the raster data generated through the image processing to the print engine **303** via the engine I/F **406**.

Next, in step S**108**, the CPU **401** acquires from the dot count unit **409** a dot count value measured at the time of the generation of the raster data. The dot count value may be acquired page by page, or may be acquired job by job.

Then, in step S**109**, the CPU **401** calculates the predicted value of the toner remaining amount, based on the dot count value acquired in step S**108**. Specifically, at first, the CPU **401** performs the following calculation: (the dot count value [dot] in print execution of this job or page)×(a toner consumption amount per dot [g/dot])=(a toner consumption amount [g] due to this job execution). Here, the toner consumption amount per dot may be stored beforehand in the ROM **402**, or may be included in the cartridge information received in step S**103**. Next, the CPU **401** performs the following calculation: (the current toner remaining amount [g])−(the toner consumption amount [g] due to the execution of this job)=(a new toner remaining amount [g]). Next, the CPU **401** performs the following calculation: (the new toner remaining amount [g])/(a toner remaining amount [g] in a state in which a cartridge is unused)=(a predicted value [%] of the new toner remaining amount). Here, the toner remaining amount in the state in which the cartridge is unused may be stored beforehand in the ROM **402**, or may be included in the cartridge information received in step S**103**.

Next, in step S**110**, the CPU **401** updates the current value of the toner remaining amount with the predicted value calculated in step S**109**.

Meanwhile, in step S**205**, the CPU **501** determines whether the raster data has been received from the controller **302** via the controller I/F **507**. When the CPU **501** determines that the raster data has been received (YES in step S**205**), the CPU **501** proceeds to step S**206**. When the CPU **501** determines that the raster data has not been received (NO in step S**205**), the CPU **501** proceeds to step S**208**.

Then, in step S**206**, the CPU **501** controls the image forming unit **508** to perform the image formation based on the raster data.

Next, in step S**207**, the CPU **501** acquires the sensor value of the toner remaining amount from the toner remaining amount sensor **504**. The sensor value may be acquired upon completion of the image formation per page, or upon completion of the image formation per job. Alternatively, the sensor value may be acquired each time a predetermined time elapses.

Then, in step S**208**, the CPU **501** determines whether there is any change between the sensor value acquired this time and a previously acquired sensor value. When the CPU **501** determines that the sensor value has changed (YES in step S**208**), the CPU **501** proceeds to step S**209**. When the CPU **501** determines that the sensor value has not changed (NO in step S**208**), the CPU **501** returns to step S**205**.

Next, in step S**209**, the CPU **501** transmits a sensor value change notification indicating that the sensor value has changed, to the controller **302** via the controller I/F **507**.

Next, in step S**111**, the CPU **401** determines whether the sensor value change notification has been received from the print engine **303** via the engine I/F **406**. When the CPU **401** determines that the sensor value change notification has been received (YES in step S**111**), the CPU **401** proceeds to step S**112**. When the CPU **401** determines that the sensor value change notification has not been received (NO in step S**111**), the CPU **401** returns to step S**105**.

Then, in step S**112**, the CPU **401** transmits a sensor value request for requesting the sensor value to the print engine **303** via the engine I/F **406**.

Next, in step S**210**, the CPU **501** determines whether the sensor value request has been received from the controller **302** via the controller I/F **507**. When the CPU **501** determines that the sensor value request has been received (YES in step S**210**), the CPU **501** proceeds to step S**211**. When the CPU

501 determines that the sensor value request has not been received (NO in step S210), the CPU 501 stays on standby.

Then, in step S211, the CPU 501 transmits the sensor value to the controller 302 via the controller I/F 507.

Next, in step S113, the CPU 401 determines whether the sensor value has been received from the print engine 303 via the engine I/F 406. When the CPU 401 determines that the sensor value has been received (YES in step S113), the CPU 401 proceeds to step S114. When the CPU 401 determines that the sensor value has not been received (NO in step S113), the CPU 401 stays on standby.

Then, in step S114, the CPU 401 updates the current value of the toner remaining amount with the sensor value received in step S113.

Next, in step S115, the CPU 401 determines whether the toner remaining amount is zero, with reference to the current value of the toner remaining amount. When the CPU 401 determines that the toner remaining amount is zero (YES in step S115), the CPU 401 completes the processing. When the CPU 401 determines that the toner remaining amount is not zero (NO in step S115), the CPU 401 returns to step S105.

Meanwhile, in step S212, the CPU 501 determines whether the toner remaining amount is zero, with reference to the sensor value of the toner remaining amount. When the CPU 501 determines that the toner remaining amount is zero (YES in step S212), the CPU 501 completes the processing. When the CPU 501 determines that the toner remaining amount is not zero (NO in step S212), the CPU 501 returns to step S205.

FIG. 6 is a diagram illustrating a data configuration of a memory tag. The memory tag is the nonvolatile storage medium included in the cartridge 509.

An entire data area 600 includes a basic area 610 and a free area 620.

The basic area 610 includes a capacity 611, a color type (YMCK) 612, a new flag 613, a page count 614, a Low-reached history 615, and an Out-reached history 616. These will be referred to as "cartridge information".

The capacity 611 indicates a toner amount that can be stored in the cartridge 509 (i.e., the toner remaining amount when the cartridge 509 is new and full). Specifically, the capacity 611 indicates the number of pages for which image formation is executable from a state in which the cartridge 509 is new.

The color type (YMCK) 612 indicates the color of the toner stored in the cartridge 509.

The new flag 613 indicates whether the cartridge 509 is new.

The page count 614 indicates the number of pages printed using the cartridge 509 (the number of pages for which image formation has been executed).

The Low-reached history 615 indicates whether the toner remaining amount of the cartridge 509 has reached a Low level (20%). The Low level is a value indicating that an amount of recording material remaining is small. This value may be a value other than 20% (e.g., 10% or 15%).

The Out-reached history 616 indicates whether the toner remaining amount of the cartridge 509 has reached an Out level (0%). The Out level is a value indicating that an amount of recording material remaining is zero. This value may be a value other than 0% (e.g., in a range of 1% to 3%).

The free area 620 includes a toner remaining amount value 621. New information can be added or a modification of information can be made to the free area 620 freely, according to a request by the CPU 501.

The toner remaining amount value 621 indicates the toner remaining amount [%] of the cartridge 509. The toner remaining amount may be stored in [g].

FIG. 7 is a flowchart illustrating details of processing for initializing the current value of the toner remaining amount.

When the processing illustrated in FIG. 7 is executed, various types of information (those described above with reference to FIG. 6) of the memory tag included in the cartridge information received in step S103 are used.

First, in step S301, the CPU 401 determines whether the memory tag is attached to the cartridge 509, based on the cartridge information received in step S103. Specifically, when the various types of information described above with reference to FIG. 6 are included in the cartridge information received in step S103, the CPU 401 determines that the memory tag is attached to the cartridge 509. Otherwise the CPU 401 determines that the memory tag is not attached to the cartridge 509. When the CPU 401 determines that the memory tag is attached to the cartridge 509 (YES in step S301), the CPU 401 proceeds to step S302. When the CPU 401 determines that the memory tag is not attached to the cartridge 509 (NO in step S301), the CPU 401 proceeds to step S308.

Next, in step S302, the CPU 401 determines whether the cartridge 509 is new based on the new flag 613. Specifically, when the new flag 613 included in the cartridge information is ON, the CPU 401 determines that the cartridge 509 is new. On the other hand, when the new flag 613 is OFF, the CPU 401 determines that the cartridge 509 is not new. When the CPU 401 determines that the cartridge 509 is new (YES in step S302), the CPU 401 proceeds to step S303. When the CPU 401 determines that the cartridge 509 is not new (NO in step S302), the CPU 401 proceeds to step S305.

Then, in step S303, the CPU 401 calculates a toner remaining amount initial value based on the capacity 611. Specifically, the CPU 401 calculates the toner remaining amount initial value by using the following expression:

$$A_i = C_t \times P_i,$$

where A_i denotes the toner remaining amount initial value [μg], C_t denotes the toner consumption amount per page of specific data [μg/sheet] (a predetermined value), and P_i denotes the number of printable pages using the specific data [sheets] (the capacity 611). A sign "×" refers to multiplication. P_i and C_t are values that are predetermined assuming a case of printing the specific data (standard data such as ISO data). The toner consumption amount C_t may be defined in a module of a program held in the ROM 402, or may be held by the memory tag of the cartridge 509 as the cartridge information. The above expression "$C_t \times P_i$" is not limited to this example of calculation. For example, a predetermined value according to the type of the cartridge 509 may be directly defined in a module of a program held in the ROM 402, or may be directly held by the memory tag of the cartridge 509 as the cartridge information.

Next, in step S304, the CPU 401 sets the calculated toner remaining amount initial value as an initial value of the current value of the toner remaining amount. Specifically, the CPU 401 divides the toner remaining amount initial value calculated in each of steps S303, S306, S307, S309, and S310, by "$C_t \times P_i$" that is the capacity when the cartridge 509 is new. As a result, the value of the toner remaining amount is obtained in "%". The CPU 401 then sets the obtained value as the initial value of the current value of the toner remaining amount.

On the other hand, when the CPU 401 determines that the cartridge 509 is not new (NO in step S302), in step S305, the CPU 401 determines whether the toner remaining amount value 621 is stored in the memory tag. Specifically, when the toner remaining amount value 621 is included in the cartridge

information received in step S103, the CPU 401 determines that the toner remaining amount value 621 is stored in the memory tag. Otherwise the CPU 401 determines that the toner remaining amount value 621 is not stored in the memory tag. When the CPU 401 determines that the toner remaining amount value 621 is stored in the memory tag (YES in step S305), the CPU 401 proceeds to step S307. When the CPU 401 determines that the toner remaining amount value 621 is not stored in the memory tag (NO in step S305), the CPU 401 proceeds to step S306.

Next, in step S306, the CPU 401 calculates a toner remaining amount initial value based on the page count 614. Specifically, the CPU 401 calculates the toner remaining amount initial value by using the following expression:

$$A_i = C_t \times P_i - C_t \times P_n,$$

where A_i denotes the toner remaining amount initial value [μg], C_t denotes the toner consumption amount per page of the specific data [μg/sheet] (a predetermined value), P_i denotes the number of printable pages using the specific data [sheets] (the capacity 611), and P_n denotes the number of print pages [sheets] (the page count 614). A sign "−" refers to subtraction. The expression used in step S306 may be used in step S303. This is because, when the cartridge 509 is new, "P_n" is 0 and therefore "$C_t \times P_n$" is also 0, so that the expression in step S306 is equivalent to the expression in step S303. In the flowchart, this case is equivalent to a case in which steps S302 and S303 are removed and the CPU 401 directly proceeds to step S305 when the CPU 401 determines that the memory tag is attached to the cartridge 509 (YES in step S301).

On the other hand, when the CPU 401 determines that the toner remaining amount value 621 is stored in the memory tag (YES in step S305), in step S307, the CPU 401 determines that the toner remaining amount value 621 is the toner remaining amount initial value.

When the CPU 401 determines that the memory tag is not attached to the cartridge 509 (NO in step S301), in step S308, the CPU 401 acquires the sensor value of the toner remaining amount, and determines whether the acquired sensor value is an indefinite value. Specifically, at first, the CPU 401 acquires the sensor value of the toner remaining amount by executing processing similar to the processing in steps S112 and S113 in FIG. 5B. When the acquired sensor value falls outside a range of 0% to 100% or acquisition of the sensor value has failed, the CPU 401 determines that the sensor value is an indefinite value. Otherwise the CPU 401 determines that the sensor value is not an indefinite value. When the CPU 401 determines that the sensor value is an indefinite value (YES in step S308), the CPU 401 proceeds to step S309. When the CPU 401 determines that the sensor value is not an indefinite value (NO in step S308), the CPU 401 proceeds to step S310.

Then, in step S309, the CPU 401 determines that a predetermined alternative value according to the ability of the toner remaining amount sensor 504 is the toner remaining amount initial value. A value expressed by "(an upper limit allowing remaining amount measurement by 1%)+1" (%) is used as the predetermined alternative value. Alternatively, when the Low level (e.g., 20%) indicating that a toner remaining amount is small is provided, and the remaining mount measurement by 1% cannot be performed for a value greater than a Low notification value, a value expressed by "(the Low notification value)+1" (%) may be used as the predetermined alternative value.

On the other hand, when the CPU 401 determines that the sensor value is not an indefinite value (NO in step S308), in step S310, the CPU 401 determines that the sensor value acquired in step S308 is the toner remaining amount initial value.

According to the present exemplary embodiment, the toner remaining amount can be appropriately set even if the toner remaining amount value is not stored in the memory tag of the cartridge when the cartridge is newly mounted.

Additional embodiments can also be realized by a computer of a system or apparatus that reads out and executes computer executable instructions recorded on a storage medium (e.g., computer-readable storage medium) to perform the functions of one or more of the above-described embodiment(s), and by a method performed by the computer of the system or apparatus by, for example, reading out and executing the computer executable instructions from the storage medium to perform the functions of one or more of the above-described embodiment(s). The computer may comprise one or more of a central processing unit (CPU), micro processing unit (MPU), or other circuitry, and may include a network of separate computers or separate computer processors. The computer executable instructions may be provided to the computer, for example, from a network or the storage medium. The storage medium may include, for example, one or more of a hard disk, a random-access memory (RAM), a read only memory (ROM), a storage of distributed computing systems, an optical disk (such as a compact disc (CD), digital versatile disc (DVD), or Blu-ray Disc (BD)™), a flash memory device, a memory card, and the like.

While the present disclosure has been described with reference to exemplary embodiments, it is to be understood that these exemplary embodiments are not seen to be limiting. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2013-179997 filed Aug. 30, 2013, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An image forming apparatus performing printing on a sheet using a recording material, the image forming apparatus comprising:

a processor;

a memory device;

a determining unit configured to determine, in a case where a containing unit storing the recording material is mounted on the image forming apparatus, whether remaining amount information indicating a remaining amount of the recording material is stored in a memory of the containing unit;

a calculating unit configured to calculate, in a case where the determining unit has determined that the remaining amount information is not stored in the memory, a remaining amount of the recording material based on a number of printed pages stored in the memory; and

a notifying unit configured to notify a user of a remaining amount indicated by the remaining amount information as the remaining amount of the recording material in a case where the determining unit has determined that the remaining amount information is stored in the memory, and to notify a user of a remaining amount calculated by the calculating unit as the remaining amount of the recording material in a case where the determining unit has determined that the remaining amount information is not stored in the memory,

wherein the determining unit, the calculating unit and the notifying unit are implemented at least in part by the processor executing at least one program recorded on the memory device.

2. The image forming apparatus according to claim **1**, wherein the calculating unit calculates the remaining amount of the recording material by subtracting a consumed amount of the recording material calculated based on the number of printed pages from a greatest amount of the recording material that can be stored in the containing unit.

3. The image forming apparatus according to claim **2**, wherein the calculating unit calculates the consumed amount of the recording material by multiplying a consumed amount of the recording material per page by the number of printed pages.

4. The image forming apparatus according to claim **2**, wherein the calculating unit calculates the greatest amount of the recording material by multiplying the consumed amount of the recording material per page by a number of printable pages stored in the memory.

5. The image forming apparatus according to claim **1**, wherein the notifying unit displays the remaining amount of the recording material on a user interface.

6. The image forming apparatus according to claim **1**, wherein the recording material is a toner and the containing unit is a cartridge.

7. An image forming apparatus performing printing on a sheet using a recording material, the image forming apparatus comprising:

a processor;

a memory device;

a first determining unit configured to determine, in a case where a containing unit storing the recording material is mounted on the image forming apparatus, whether the containing unit is new;

a second determining unit configured to determine, in a case where the first determining unit has determined that the containing unit is not new, whether remaining amount information indicating a remaining amount of the recording material is stored in a memory of the containing unit;

a calculating unit configured to calculate, in a case where the second determining unit has determined that the remaining amount information is not stored in the memory, a remaining amount of the recording material based on a number of printed pages stored in the memory;

a notifying unit configured to notify a user of a greatest amount of the recording material that can be stored in the containing unit as the remaining amount of the recording material in a case where the first determining unit has determined that the containing unit is new, to notify a user of the remaining amount of the recording material indicated by the remaining amount information as the remaining amount of the recording material in a case where the second determining unit has determined that the remaining amount information is stored in the memory, and to notify a user of the remaining amount of the recording material calculated by the calculating unit in a case where the second determining unit has determined that the remaining amount information is not stored in the memory,

wherein the first determining unit, the second determining unit, the calculating unit and the notifying unit are implemented at least in part by the processor executing at least one program recorded on the memory device.

8. The image forming apparatus according to claim **7**, wherein the first determining unit determines whether the containing unit is new based on a new flag stored in the memory.

9. The image forming apparatus according to claim **7**, wherein the greatest amount of the recording material is calculated by multiplying a consumed amount of the recording material per page by a number of printable pages stored in the memory.

10. The image forming apparatus according to claim **7**, wherein the calculating unit calculates the remaining amount of the recording material by subtracting a consumed amount of the recording material calculated based on the number of printed pages from the greatest amount of the recording material.

11. The image forming apparatus according to claim **10**, wherein the calculating unit calculates the consumed amount of the recording material by multiplying a consumed amount of the recording material per page by the number of printed pages stored in the memory.

12. The image forming apparatus according to claim **10**, wherein the calculating unit calculates the greatest amount of the recording material by multiplying a consumed amount of the recording material per page by the number of printable pages stored in the memory.

13. The image forming apparatus according to claim **7**, wherein the notifying unit displays the remaining amount of the recording material on a user interface.

14. The image forming apparatus according to claim **7**, wherein the recording material is a toner and the containing unit is a cartridge.

15. A method of controlling an image forming apparatus that performs printing on a sheet using a recording material, the method comprising:

determining, in a case where a containing unit storing the recording material is mounted on the image forming apparatus, whether remaining amount information indicating a remaining amount of the recording material is stored in a memory of the containing unit;

calculating, in a case where the determining unit has determined that the remaining amount information is not stored in the memory, a remaining amount of the recording material based on a number of printed pages stored in the memory; and

notifying a user of a remaining amount indicated by the remaining amount information as the remaining amount of the recording material in a case where a determination has been made that the remaining amount information is stored in the memory, and notifying a user of a calculated remaining amount as the remaining amount of the recording material in a case where a determination has been made that the remaining amount information is not stored in the memory.

16. A method of controlling an image forming apparatus that performs printing on a sheet using a recording material, the method comprising:

determining, in a case where a containing unit storing the recording material is mounted on the image forming apparatus, whether the containing unit is new;

determining, in a case where the it has been determined that the containing unit is not new, whether remaining amount information indicating a remaining amount of the recording material is stored in a memory of the containing unit;

calculating, in a case where it has been determined that the remaining amount information is not stored in the

memory, a remaining amount of the recording material based on a number of printed pages stored in the memory;

notifying a user of a greatest amount of the recording material that can be stored in the containing unit as the remaining amount of the recording material in a case where a determination has been made that the containing unit is new;

notifying a user of the remaining amount of the recording material indicated by the remaining amount information as the remaining amount of the recording material in a case where a determination has been made that the remaining amount information is stored in the memory; and

notifying a user of the calculated remaining amount of the recording material in a case where a determination has been made that the remaining amount information is not stored in the memory.

17. A non-transitory computer readable storage medium storing instructions that, when executed by a processor, execute a method of controlling an image forming apparatus that performs printing on a sheet using a recording material, the method comprising:

determining, in a case where a containing unit storing the recording material is mounted on the image forming apparatus, whether remaining amount information indicating a remaining amount of the recording material is stored in a memory of the containing unit;

calculating, in a case where the determining unit has determined that the remaining amount information is not stored in the memory, a remaining amount of the recording material based on a number of printed pages stored in the memory; and

notifying a user of a remaining amount indicated by the remaining amount information as the remaining amount of the recording material in a case where a determination has been made that the remaining amount information is stored in the memory, and notifying a user of a calculated remaining amount as the remaining amount of the recording material in a case where a determination has been made that the remaining amount information is not stored in the memory.

18. A non-transitory computer readable storage medium storing instructions that, when executed by a processor, execute a method of controlling an image forming apparatus that performs printing on a sheet using a recording material, the method comprising:

determining, in a case where a containing unit storing the recording material is mounted on the image forming apparatus, whether the containing unit is new;

determining, in a case where the it has been determined that the containing unit is not new, whether remaining amount information indicating a remaining amount of the recording material is stored in a memory of the containing unit;

calculating, in a case where it has been determined that the remaining amount information is not stored in the memory, a remaining amount of the recording material based on a number of printed pages stored in the memory;

notifying a user of a greatest amount of the recording material that can be stored in the containing unit as the remaining amount of the recording material in a case where a determination has been made that the containing unit is new;

notifying a user of the remaining amount of the recording material indicated by the remaining amount information as the remaining amount of the recording material in a case where a determination has been made that the remaining amount information is stored in the memory; and

notifying a user of the calculated remaining amount of the recording material in a case where a determination has been made that the remaining amount information is not stored in the memory.

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